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ABSTRACT

The Teacher Education and Learning to Teach Study of the National Center for Research on Teacher Education combines case studies of teacher education programs with longitudinal studies of teacher learning. In this paper, the development of the theoretical framework on which instrumentation for the longitudinal study is based is discussed. Organized around four commonplaces of knowledge central to teaching--subject matter knowledge, teaching and learning, pupils, and context--the framework grounds researchers' efforts to learn how teachers and prospective teachers weave together different kinds of considerations in teaching mathematics and writing to diverse learners. Strategies developed include a questionnaire, interviews, and an observation guide. The paper describe how these instruments were designed to be accessible to respondents with different views of good teaching. The paper concludes by setting the longitudinal component of the study in the broader context of the overall research mission and agenda. (Author)

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"MANY MOONS": UNDERSTANDING TEACHER LEARNING FROM A TEACHER EDUCATION PERSPECTIVE

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NCRTE

National Center for Research on Teacher Education

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National Center for Research on Teacher Education

The National Center for Research on Teacher Education (NCRTE) was founded at Michigan State University in 1985 by the Office of Educational Research and Improvement, U.S. Department of Education.

The NCRTE is committed to improving teacher education through research on its purposes, its character and quality, and its role in teacher learning. NCRTE defines teacher education broadly and includes in its portfolio such diverse approaches as preservice, inservice, and induction programs and alternate routes to teaching.

To further its mission, the NCRTE publishes research reports, issue papers, technical series, conference proceedings, and a newsletter on contemporary issues in teacher education. For more information about the NCRTE or to be placed on its mailing list, please write to the Editor, National Center for Research on Teacher Education, 516 Erickson Hall, Michigan State University, East Lansing, Michigan 48824-1034.

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Abstract

The Teacher Education and Learning to Teach Study of the National Center for Research on Teacher Education combines case studies of teacher education programs with longitudinal studies of teacher learning. In this paper, the authors discuss the development of the theoretical framework on which instrumentation for the longitudinal study is based. Organized around four commonplaces of knowledge central to teaching--subject matter knowledge, teaching and learning, pupils, and context--the framework grounds researchers' efforts to learn how teachers and prospective teachers weave together different kinds of considerations in teaching mathematics and writing to diverse learners. Strategies developed include a questionnaire, interviews, and an observation guide. The authors describe how these instruments were designed to be accessible to respondents with different views of good teaching. The paper concludes by setting the longitudinal component of the study in the broader context of the overall research mission and agenda.

MANY MOONS*

G. Williamson McDiarmid and Deborah Loewenberg Ball**

Introduction

To frame our discussion of teacher learning and how researchers from the National Center for Research on Teacher Education are studying this learning, we will draw on a fairy tale written by James Thurber (1943).

In Many Moons, the King's daughter becomes ill of a surfeit of raspberry tarts. When the King asks her what will make her well, she replies, "The moon." The King then summons his royal counselors and asks them to produce the moon to restore Princess Lenore's health. The Lord High Chamberlain protests that the moon is 35,000 miles away, is bigger than the princess's bedroom, and is made of molten copper. The Royal Wizard, in his turn, claims that the moon is 150,000 miles away, is made of green cheese, and is twice as big as the palace. Lastly, the Royal Mathematician allows as how the moon is 300,000 miles away, is flat like a coin, is made of asbestos, is half the size of the kingdom, and is pasted to the sky.

When he comes to console his depressed monarch with music, the Court Jester learns about the royal counselors' competing images of the moon. He concludes, "The moon must be just as large and far away as each person thinks

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*A version of this paper was presented at the annual meeting of the American Educational Research Association in New Orleans, Louisiana, April 7, 1988 and will appear in The Journal of the Michigan and Ohio Associations of Teacher Educators

**G. Williamson McDiarmid is associate director of the National Center for Research on Teacher Education and an assistant professor of teacher education at Michigan State University. Deborah Ball, an NCRTE senior researcher, is an instructor in teacher education at MSU. The authors wish to acknowledge Suzanne Wilson who contributed to both the language and ideas in this paper.

it is." When the Jester asks the Princess how big and far away the moon is, she replies, "It's just a little smaller than my thumbnail . . . and not as high as the big tree outside my window." The tiny golden moon on a golden chain that the Jester has made to match the Princess's image soon makes her well again.

The royal advisers' disagreements about the size and whereabouts of the moon resemble the disagreements about what teachers need to know in order to teach and about how and where they learn what they need to know. Some claim that what teachers need to know can be identified, verified, systematized, and taught. Others claim that most of what teachers need to know comes directly from classroom experience and defies codification. Some argue that what teachers need to know and be able to do is more or less the same regardless of the subject matter. Others contend that a good liberal arts education with a major in a genuine academic discipline is the best qualification for teaching.

Matching Models or Creating Pictures?

When Center researchers delved into the issue of teacher knowledge, we found, like the King in Thurber's story, assertions and counter-assertions about what knowledge and skills teaching entails. The issue is critical to our work: We want to find out how teachers'--and prospective teachers'--knowledge changes while and after they are involved in formal teacher education programs. Consequently, just as the Court Jester asks the Princess about her image of the moon, we want to enable teachers to tell--or show--us what they know about teaching.[1]

Most evaluation efforts begin with a implicit or explicit model of good teaching--like the royal counselors' models of the moon. Individual teachers are evaluated for how well they fit the model. We did not want to compare

teachers' knowledge and skills to some preconceived image of good teaching but rather to get teachers to tell or show us what they knew and were able to do.

Our goal became to create canvasses on which teachers and prospective teachers would portray what they knew, what they cared about, and what they were able to do.[2] As we wanted to be able to compare the knowledge and understandings of teachers who were exposed to different teacher education programs, we needed to ensure that the portraits they produced were comparable. To create the conditions for this, we give teachers a focus, asking them how they understand and would teach specific topics in mathematics and writing. Having teachers talk about a common topic may be compared to painting common themes in art: Leonardo Da Vinci, Gilbert Stuart, Marc Chagall, and Andrew Wyeth all painted portraits of women, although the images they produced are remarkably different in content, composition, medium, form, texture, and mood.

We set as our primary task, then, to find out what teachers and prospective teachers learn about teaching academic subject matter--specifically, mathematics and writing--to diverse students. We chose mathematics and writing because they are contrasting content areas, because they are taught from kindergarten through high school, because pupils frequently have problems learning them, and because current practices used in teaching these subjects in schools frequently differ from those recommended in the growing bodies of research in both areas. Having decided to focus on teachers' knowledge of math and writing for teaching, we identified differing views of good math or writing teaching to ensure that the tasks we set for teachers allowed different, even competing views, of good teaching to emerge. We chose teacher education programs that appear to vary in the kinds of knowledge and skills they try to help teachers develop.[3] Our instruments should, therefore, be sensitive to change in competing views about what teachers need to know.

For instance, in mathematics, we should be able to measure and track changes in teachers' knowledge of computational procedures and algorithms as well as in their understanding of mathematical ideas such as division and slope. In a program designed to promote a diagnostic-prescriptive approach to teaching math, faculty would probably expect graduates to know certain specific teaching strategies, mathematical "rules of thumb," and error patterns likely to appear in pupils' work. Faculty in a program that purports to focus on conceptual understanding would probably expect their graduates to know how ideas in mathematics are connected, what principles underlie particular mathematical procedures as well as how to represent the meaning of specific content. We want to be able to keep track of how teachers knowledge changes in both programs--as well as in programs that emphasize other views of mathematics.

To this end, Center researchers reviewed the literature in the fields of teaching mathematics and writing and began a dialogue with practitioners in each field. Our purpose in these reviews was to map different perspectives on how mathematics and writing should be taught so that we could create instruments sensitive to a wide range of knowledge, skills, and dispositions believed necessary for teaching.

What Goes Into Teaching?

Our interest in what teachers know goes beyond their propositional knowledge. In teaching, what teachers do and think depends on not only what they know but also what they are able to do and what they are disposed to do. Typically, teacher educators and policymakers focus on narrowly defined knowledge and skills, treating them as distinct categories. While perhaps useful in analyzing teaching behaviors, this distinction conveys the mistaken impression that skills can somehow exist independently of knowledge.[4]

For example, asking good questions is frequently cited as a skill necessary for effective teaching. Characteristics of good questions--such as "allowing for more than one response"--or good questioning behavior--such as sufficient "wait time"--are used to define the skill. Good questions, like good explanations, depend, however, on teachers' subject matter understanding. Can a teacher whose understanding of the American Civil War extends no further than the three causes listed in the teachers' guide ask a question that will involve pupils in thinking about what the Civil War represents? Questions that elicit recitations of the causes of the Civil War differ qualitatively from those that ask students to think about the evolution of the United States from a loose organization of states whose leaders often disagreed on fundamental goals and directions to a nation-state pursuing widely shared economic and social goals.

Asking good questions also depends on teachers' commitments and orientations--in short, on their dispositions. A teacher who is herself curious about the Civil War and its significance in the evolution of the United States is likely to ask very different questions at different times and in different ways (i.e., tone, phrasing, and so on) than is a teacher for whom the Civil War is another topic in the curriculum guide that must be covered. The first teacher may ask questions that she is curious about, that she thinks her students will find interesting, and that are likely to encourage pupils to think about the events and circumstances and their interrelationships that lead to a better understanding of the Civil War (and, ultimately, of the history of humankind). The second teacher is more likely to ask the questions suggested in the teachers' guide which may or may not be responsive to the thinking or understandings of her pupils. Her own limited understanding of history does not enable her--or dispose her--to engage students in the kinds of discussions

and considerations that some would argue are at the heart of historical inquiry.

This example shows that teacher knowledge involves a great deal more than questioning strategies or skills. Among other things, teacher knowledge includes knowing about subject matter, about students and their backgrounds, and about ways to engage them in thinking about content.

In developing our instruments for recording and tracking changes in what teachers know, we sought to ensure that we would gather information on the full range of what teachers know--not just their teaching skills, their subject matter knowledge, or their understanding of students and how they learn. We also wanted to find out how they bring what they know about these different dimensions of teaching together in the act of teaching. How do they decide that the exigencies of the subject matter are such that they override what they know about students and their background? What do they do when contextual factors seem to preclude dealing with topics they think are critical to understanding subject matter?

Our Canvasses[5]

We consequently produced three types of canvases. The first is a conventional questionnaire in which we are concerned primarily with teachers' beliefs and their propositional and procedural knowledge of math and writing. For instance, we ask teachers what they think "being good" at math and writing means to them. Their responses help us understand what they think is the nature--or "essence"--of mathematics and writing. A person who thinks that "being good" at math means remembering formulas and procedures probably has a quite different view of the nature of mathematics than does someone who thinks that "being good" at math means being able to think flexibly.[6]

We also include subject matter knowledge items to find our about their propositional understanding of topics in math and writing. We ask them, for instance, to compare two pieces of student writing and identify the criteria they use in evaluating writing. In math, we ask them to identify appropriate mathematical representations for a numerical expression.

Our second instrument for recording teacher knowledge--and the one described most fully in this article--is a structured interview. After a series of questions in which we ask teachers and prospective teachers about their experiences as learners of math and writing, we present them with several teaching scenarios. We developed these scenarios around common teaching tasks such as deciding what to teach, responding to student errors, and determining what students have learned.[7] In responding to these scenarios, the teachers in our study reveal not only their understanding of the subject matter but how they are disposed to view and treat particular classroom situations as well.[8]

Finally, we observe the teachers teaching. In seeing how they actually carry out teaching tasks, we expect to find out even more about their dispositions as well as how they deal with diversity, how they transform their subject matter for teaching, and how they seem to understand the subject matter they teach among other things. These observations include interviews before and after class to find out how and why teachers decide to teach what they teach, arrange their classrooms as they do, treat different kinds of students, and find out what students learn.[9]

Each of these canvasses offers incomplete opportunities for teachers to reveal what they know. By presenting teachers several opportunities--"canvasses"--to display what they know and are inclined and able to do, we hope to compensate for the weaknesses inherent in each.[10]

What Will Teachers Portray On These Canvasses?

When the King's counselors described their understanding of the moon in Thurber's story, they revealed not only what they knew about the moon but other things as well. For instance, they revealed their knowledge of the compositions of celestial bodies (molten copper, green cheese, and--certain to concern the Occupational Safety and Health Administration--asbestos), as well as of the relationship between the size of an object and its distance from the observer (35,000 miles away and bigger than the Princess's bedroom). Finally, the Royal Mathematician, no doubt emboldened by the close historical evolution of mathematics and astronomy, volunteers that the moon is pasted to the sky. We learn a lot about what these allegedly learned men know--or think that they know.

Similarly, in trying to understand teachers' thinking and actions, we need to learn what they know (or think they know). When we set about creating our instruments for examining teacher knowledge, we wanted to be sure that we found out what they knew about the commonplaces of teaching--teaching and learning, subject matter, learners, context, and learning to teach.[11]

We want to find out, for instance, what teachers and prospective teachers know about working with pupils--that is, their repertoire of ways for helping pupils understand mathematics and learn to write, for figuring out what pupils know, and for deciding what to do in the classroom and doing it. At the same time, we want to discover what teachers know and believe about the learning process. What do they think it means to "learn" something? How do they think learning occurs? To what degree do they believe themselves responsible for pupil learning? Equally critical is what they know and how they think about learners. In teaching math and writing, what factors--age, level of development, cultural background, prior experience with the topic, and so on--do they take into account, why and how?

We also want to know what teachers and prospective teachers understand about mathematics and writing. From whatever view one takes of good teaching, teachers' own knowledge of subject matter is critical. What do they think "doing" math involves--following rules and procedures, discussing problems, completing computations, or figuring out what a problem is about? What do they themselves know about certain central topics in math--for example, division, slope, and proof--and what role does their knowledge play in their capacity to help their pupils learn about these topics?

Another commonplace of teaching that we want to explore is the role of context. What aspects of the context--classroom, school, community, national, international--do teachers take into account in thinking about teaching? How do they think contextual factors influence the teaching and learning of math and writing? Because of our interest in learning to teach, we also want to find out where and how teachers think they learn whatever it is that they believe they need to know.

For these commonplaces, we not only want to find out what teachers know about each but how their knowledge changes while and after they are involved in formal teacher education programs. Teachers do not, obviously, think in these or any other categories. Their thinking is of a piece. We impose these categories on teacher thinking and actions to understand better what teachers draw on in teaching. In developing our instruments, our goal has been to construct tasks that draw on teachers' knowledge, integrated and whole, as do the tasks of teaching.

An Example from a Canvas

In constructing the scenarios for the interview, we have created pictures with some elements--such as the teaching task, the subject matter topic or

problem, and the grade level--sketched in. For instance, we ask teachers how they would respond to an excited pupil who brought them a theory about the relationship of the perimeter of a figure to its area. We are interested in what teachers and prospective teachers make of the information we include. Do they attend primarily to the mathematics or do they focus on the initiative and curiosity that the pupil displays? What do they think is at issue in the mathematics? Do they focus on whether the pupil's theory is right or wrong or on her use of a single example to establish the validity of her claim? Are they bothered by the lack of contextual details in the scenario?

We are also interested in how teachers understand perimeter and area and what they think about the relationship between them. From the data we have already collected on this item, we have learned that teachers and prospective teachers often are not sure whether or not the relationship that the pupil proposes is actually true. We want to know how these people think about the pupil's claim. Are they skeptical or inclined to believe it? Why?

How teachers respond reveals how they think about mathematics--that is, is math amenable to reasoning or is it a matter of learning a body of propositions, rules, and procedures? To resolve their uncertainty, would the teachers "look it up" or are they inclined to think about it, to test out other examples, to involve other students in figuring out whether or not the hypothesis stands up? In this example, we also want to know how teachers and prospective teachers think about the evidence or warrants required to establish something as "true." Does one example constitute sufficient proof? If not, what would the teachers consider adequate evidence for the claim?

Our interest is not, however, solely in teachers' and prospective teachers' understanding of the mathematics involved in the scenario. We also want to find out how their understanding of the mathematics interacts with

their knowledge and understanding of teaching and learning. How do they say they would respond to the pupil? One respondent said she would tell the pupil "she was wrong and show her an example," while another who also knew the pupil's claim to be false took a different tack: He said he'd challenge the pupil to find an example in which the perimeter changes but the area does not. In their responses, these two teachers--both of whom know the content in similar ways--reveal quite different understandings about how mathematics is learned and about their roles in the learning process.

Although we have sketched in some mathematical issues and a teaching task, teachers and prospective teachers construe the embedded issues and tasks quite differently. In telling us what they think the issues and tasks are and by telling us what they would do in the situation, they portray for us what they know and think about the relationship of area and perimeter, about the use of examples as proof, about the nature of proof in math as well as about how they think math is best learned and taught and how they deal with pupils who come up with novel ideas. As we are asking teachers to respond to the interview scenarios at several points in time, we will be able to see how their knowledge appears to change as well as changes that occur in what they pay attention to. In short, we get <u>their</u> picture of the moon--at several different points in time.

How Teachers' Knowledge Changes Over Time

We are also gathering information on the programs in which these teachers and prospective teachers are enrolled. We are gathering data on preservice, fifth-year, alternate route, and inservice programs. By surveying and interviewing faculty and staff about what they teach and why, by observing critical courses and workshops, and by observing guided practice and the

discussions that surround these, we are finding out what teachers and prospective teachers have an opportunity to learn. Our intention is to describe the character and quality of these opportunities.

While we do not believe we can establish causal links between opportunities to learn and what teachers seem to learn about teaching math and writing to diverse students, we will be able to talk about changes in the knowledge, skills, and dispositions of teachers during and after their involvement with programs that seem to differ substantially in approach, purpose, context, and perspective. Our goal is less to establish causality and more to explore some of the assumptions and assertions made about how teachers learn to teach and the role that formal teacher education plays in the process.

For instance, a common assumption is that what prospective teachers really need to know to be able to teach can only be learned through direct classroom experience. We are studying teachers in both conventional preservice programs as well as teachers in alternate route programs that place beginning teachers in classrooms with no preparation beyond a few weeks of orientation. While we won't be able to say--nor are we interested in saying--that one program is "better" than another, we will be able to say what teachers seem to learn about teaching math and writing to diverse students in each program. Whether one of the approaches is "better" than the other depends on what you think teachers need to know and be able to do in order to teach.

Conclusion

Unlike the King in Thurber's tale, we aren't so much interested in establishing truth--that is, which approach to teacher education is best--as in finding out how different approaches to educating teachers influence what teachers know and are able to do and disposed to do. Rather than being

frustrated by different conceptions of the moon, we are interested to know not only what teachers and prospective teachers' conceptions of teaching are but where those conceptions come from. In fact, if we were interviewing the Royal Wizard and he told us that the moon is 150,000 miles away, is made of green cheese, and is twice as big as the palace, we'd probably say, "That's interesting. Why do you think that? Where did you get those ideas?"

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Footnotes

[1]Our primary device for finding out what teachers know are the teaching scenarios to which we ask teachers and prospective teachers to respond. We have used these because we feel they are likely to produce data on teacher knowledge that is more valid than questions that ask teachers directly what they know. The scenarios describe situations with which all teachers have to grapple, regardless of their views of good teaching. The teachers whom we interview interpret and respond to these situations based on what they know and believe. This enables us to learn about their knowledge and beliefs.

We do not, however, wish to convey the impression that we believe that the teachers and prospective teachers we are studying will have the opportunity to show and tell us all they know about teaching math and writing to diverse students. The conditions under which we gather our data--that is, written questionnaires, face-to-face interviews, and classroom observations--also shape what interviewees say and do. While such effects are, given our research design, unavoidable, we recognize that, in reporting our findings, we are obliged to alert our readers to the conditions under which our data were gathered and the possible biases that these conditions could produce. Moreover, as we have selected a sample of topics in math and writing and as we ask about these in contexts that we have contrived, we constrain teachers' opportunities to tell us what they know about other topics.

[2]The description that follows refers primarily to the interviews we conducted with teachers and prospective teachers. Later, we will describe our questionnaire and observation instrument.

[3]We have tried to avoid reifying programs by assuming that a program "has a point of view" on what teachers need to know, care about, and be able to do. We are attempting to discover, in fact, the degree to which faculty and staff in the 11 programs we are studying share a common view on the knowledge and skills necessary for teaching and, if it exists, what that common view is in each program.

[4]Gilbert Ryle (1949) ridiculed the artificial separation of knowledge and skill as "the dogma of the Ghost in the Machine." Using a clown's antics as a metaphor for his argument, Ryle contends that the audience applauds the clown's skill at seeming clumsy, "not some extra hidden performance executed 'in his head'" (p. 33). Ryle continues by pointing out that

> Tripping on purpose is both a bodily and a mental process, but it is not two processes, such as one process of purposing to trip and, as an effect, another process of tripping. Yet the old myths die hard. We are tempted to argue that if the clown's antics exhibit carefulness, judgment, wit, and appreciation of the moods of his spectators, there must be occurring in the clown's head a counterpart performance to that which is taking place on the sawdust. (pp. 33-34)

Knowing how, therefore, entails knowing that.

[5]The National Center for Research on Teacher Education will make available the instruments described in this article in 1989.

[6]Over 700 prospective and inservice teachers and liberal arts majors at the 11 programs in our sample have completed questionnaires in the first wave of data collection.

[7]For example, the following is a scenario item from the writing section of the interview:

> Now imagine that you have just taken a job teaching fifth grade students in an inner-city school. Early in the school year you ask your students to write autobiographies. Your main goal for this assignment is to get your students comfortable with writing. One student is not writing. When you ask him why, he says he has nothing to write.
>
> a. How would you respond to this student?
> b. What would you do? Why?
> c. Are there other alternatives you might try?

[8]We have interviewed over 160 teachers, perspective teachers, and liberal arts majors at the 11 sites in our sample during the first wave of data collection. We will interview most of these people twice more during the study.

[9]The purpose of the observations is not, principally, to "verify" what teachers have told us in our interviews with them. Nor do we wish to compare teacher behaviors with a predetermined set of behaviors that are associated with a particular view of good teaching. Rather, teacher actions are another expression of what they know. Some categories--dispositions, for instance--are best revealed in an individual's actions. Whereas direct questions about their views of diversity are likely to provoke social responses, teachers, in their own classrooms, reveal through their actions--how they arrange their classes, how they ask questions, what opportunities they create for pupils to be involved in activities, what representations they create for their subject matter, and so on--their dispositions toward diversity. Observing teachers in their own classrooms also provides information on how they bring together and balance their knowledge--of teaching and learning, subject matter, pupils, and context--in teaching a lesson.

[10]The questionnaire, for instance, like most paper-and-pencil instruments, does not provide a context for the respondent to answer nor for researchers to interpret the response. Because we didn't want to cue informants as to what we are looking for, some of the scenario items in the interviews lack specific questions on such dimensions as knowledge of diversity and context. Consequently, if informants don't mention these dimensions, we don't know if that means they don't think about diversity or contextual issues, for example, or if they just failed to mention these things. The topics that we ask about in the interviews, furthermore, represent a sample of the possible topics in the fields of writing and math. Finally, interviews are not teaching: What people say they would do may or may not resemble what they would actually do in a classroom.

Because of resource limitations, we can only observe prospective teachers twice--during student teaching and, then, during their first year of teaching. While we observe some practicing teachers three times, most we can only observe twice. While <u>individually</u> the instruments have weaknesses and drawbacks,

cumulatively they produce a fairly detailed portrait of what teachers know, care about, and can do.

[11]While Schwab (1978) is the source for the notion of "commonplaces," we've played fast and loose with his initial categories of the teacher, the subject matter, the learner, and the milieu. We've found, in analyzing how teachers think about the teaching tasks we've set them, that implicit in their notions about teaching--the role of teacher as well as the goals and process of teaching--are ideas about how learning occurs. We treat, consequently, teaching and learning as reciprocals. We also include "learning to teach" because of the central role that this idea plays in the study.